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DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. FAA-2013-0772; Special Conditions No. 25-520A-SC]

Special Conditions: Embraer Model EMB-550 Airplanes; Flight Envelope Protection: Normal Load Factor (g) Limiting

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final special conditions.

SUMMARY: These amended special conditions are issued for Embraer Model EMB-550 airplanes. This airplane will have novel or unusual design features when compared to the state of technology envisioned in the airworthiness standards for transport category airplanes. This design feature is associated with an electronic flight control system that prevents the pilot from inadvertently or intentionally exceeding the positive or negative airplane limit load factor. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. These special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

DATES: Effective [INSERT DATE OF PUBLICATION IN THE FEDERAL REGISTER].

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SUPPLEMENTARY INFORMATION:

Background

On August 9, 2016, Embraer applied for a change to Type Certificate No. TC00062IB to include additional flexibility to the normal load factor limit on the Embraer Model EMB-550 airplane, by requesting an amendment to the existing Embraer Model EMB-550 Special Conditions No. 25-520-SC as a result of harmonization efforts in the Flight Test Harmonization Working Group (FTHWG). The Embraer Model EMB-550 airplane, currently approved under Type Certificate No. TC00062IB, is a twin-engine, transport category airplane with a maximum takeoff weight of 42,857 pounds. The Embraer Model EMB-550 has a maximum seating capacity of 12 passengers.

Type Certification Basis

Under the provisions of title 14, Code of Federal Regulations (14 CFR) 21.101, Embraer must show that the Embraer Model EMB-550 airplane, as changed, continues to meet the applicable provisions of the regulations listed in Type Certificate No. TC00062IB or the applicable regulations in effect on the date of application for the change, except for earlier amendments as agreed upon by the FAA.

If the Administrator finds that the applicable airworthiness regulations (i.e., 14 CFR part 25) do not contain adequate or appropriate safety standards for the Embraer Model EMB-550 airplane because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

Special conditions are initially applicable to the model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same novel or unusual design feature, or should any other model already included on the same type certificate be modified to incorporate the same novel or unusual design feature, these special conditions would also apply to the other model under § 21.101.

In addition to the applicable airworthiness regulations and special conditions, the Embraer Model EMB-550 airplane must comply with the fuel vent and exhaust emission requirements of 14 CFR part 34 and the noise certification requirements of 14 CFR part 36.

The FAA issues special conditions, as defined in 14 CFR 11.19, in accordance with § 11.38, and they become part of the type certification basis under § 21.101.

Novel or Unusual Design Features

The Embraer Model EMB-550 airplane will incorporate the following novel or unusual design features:

The Embraer Model EMB-550 airplane flight control system design incorporates normal load factor limiting on a full-time basis that will prevent the pilot from inadvertently or intentionally exceeding the positive or negative airplane limit load factor. This feature is considered novel and unusual in that the current regulations do not provide standards for maneuverability and controllability evaluations for such systems.

Discussion

The normal load factor limit on the Embraer Model EMB-550 airplane is unique in that traditional airplanes with conventional flight control systems (mechanical

linkages) are limited in the pitch axis only by the elevator surface area and deflection limit. The elevator control power is normally derived for adequate controllability and the maneuverability at the most critical longitudinal pitching moment. The result is that traditional airplanes have a significant portion of the flight envelope where maneuverability in excess of limit structural design values is possible. The Embraer Model EMB-550 airplane because of the normal load factor limit does not have this excess maneuverability.

Title 14, Code of Federal Regulations (14 CFR) part 25 does not specify requirements for demonstrating maneuver control that impose any handling qualities requirements beyond the design limit structural loads. Nevertheless, some pilots are accustomed to the availability of this excess maneuver capacity in case of extreme emergency such as upset recoveries or collision avoidance.

As a result of harmonization efforts with other civil aviation authorities through the Flight Test Harmonization Working Group (FTHWG) and Embraer's request to incorporate them into Special Conditions No. 25-520-SC, the FAA is including additional flexibility in maneuverability limits by amending the existing Embraer Model EMB-550 airplane Special Conditions No. 25-520-SC. This additional flexibility allows for reduced maneuverability limits beyond V_{mo}/M_{mo} . The existing special conditions are otherwise unchanged.

The special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

Discussion of Comments

The FAA issued Notice of Proposed Special Conditions No. 25-19-01-SC for the Embraer Model EMB-550 airplane, which was published in the *Federal Register* on April 8, 2019 (84 FR 13838). The FAA received a response from one commenter, while generally supporting the new technology requested a thorough review of the system reliability and failure modes. The comment is already addressed in § 25.1309, Equipment, systems, and installations.

Applicability

As discussed above, these special conditions are applicable to the Embraer Model EMB-550 airplane. Should Embraer apply at a later date for a change to the type certificate to include another model incorporating the same novel or unusual design feature, these special conditions would apply to that model as well.

Under standard practice, the effective date of final special conditions would be 30 days after the date of publication in the *Federal Register*. However, as the certification date for the Embraer Model EMB-550 airplane is imminent, the FAA finds that good cause exists to make these special conditions effective upon publication.

Conclusion

This action affects only certain novel or unusual design features on one model of airplane. It is not a rule of general applicability.

List of Subjects in 14 CFR Part 25

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

Authority Citation

The authority citation for these special conditions is as follows:

Authority: 49 U.S.C. 106(f), 106(g), 40113, 44701, 44702, 44704.

The Special Conditions

Accordingly, pursuant to the authority delegated to me by the Administrator, the following special conditions are issued as part of the type certification basis for Embraer Model EMB-550 airplanes.

1. To meet the intent of adequate maneuverability and controllability required by § 25.143(a), and in addition to the requirements of § 25.143(a) and in the absence of other limiting factors, the following special conditions are based on § 25.333(b):
 - a. The positive limiting load factor must not be less than:
 - (1) 2.5g for the normal state of the electronic flight control system with the high lift devices retracted up to V_{mo}/M_{mo} . The positive limiting load factor may be gradually reduced down to 2.25g above V_{mo}/M_{mo} .
 - (2) 2.0g for the normal state of the electronic flight control system with the high lift devices extended.
 - b. The negative limiting load factor must be equal to or more negative than:
 - (1) Minus 1.0g for the normal state of the electronic flight control system with the high lift devices retracted.
 - (2) 0.0g for the normal state of the electronic flight control system with high lift devices extended.
 - c. Maximum reachable positive load factor wings level may be limited by the characteristics of the electronic flight control system or flight envelope protections (other than load factor protection) provided that:

- (1) The required values are readily achievable in turns, and
 - (2) Wings level pitch up responsiveness is satisfactory.
- d. Maximum achievable negative load factor may be limited by the characteristics of the electronic flight control system or flight envelope protections (other than load factor protection) provided that:
 - (1) Pitch down responsiveness is satisfactory, and
 - (2) From level flight, 0g is readily achievable or alternatively, a satisfactory trajectory change is readily achievable at operational speeds. For the FAA to consider a trajectory change as satisfactory, the applicant should propose and justify a pitch rate that provides sufficient maneuvering capability in the most critical scenarios.
- e. Compliance demonstration with the above requirements may be performed without ice accretion on the airframe.

- f. These special conditions do not impose an upper bound for the normal load factor limit, nor does it require that the limiter exist. If the limit is set at a value beyond the structural design limit maneuvering load factor “n” of §§ 25.333(b), 25.337(b) and 25.337(c), there should be a very obvious positive tactile feel built into the controller so that it serves as a deterrent to inadvertently exceeding the structural limit.

Issued in Des Moines, Washington, on May 2, 2019.

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